THE INCOME ELASTICITY OF THE TAX YIELD IN JAPAN

By HIROMITSU ISHI*

I. *Introduction*

It is well known that tax revenues obtained according to given statutory rates will fluctuate with changes in the national income. Tax revenues increase during periods of inflation and diminish during periods of deflation since the size of the tax base usually varies directly with the level of national income. Such movements in tax revenues can bring about countercyclical or compensatory effects, made possible by the mechanism of "build-in flexibility" in the given tax structures. Thus the tax system automatically adjusts itself to stabilize the total income of the economy.

This stabilizing function will be analyzed in this paper using the concept of "elasticity." The concept of income elasticity of the tax yield, which will be henceforward called the "tax-income elasticity," may be defined as the ratio of the percentage change in tax yield to a given percentage change in income. Let us suppose, for instance, that the value of this tax-income elasticity is significantly greater than unity. There are a priori reasons for expecting the income changes to be sensitive to cycles if there are no changes in the tax system. As the national income rises in the boom periods, the tax yield will rise and automatically lead to an increase in budget surplus or a reduction in budget deficits. This process will restrain increases in demand and check inflationary pressures. Vice versa, when income and employment drop during depressions, the tax yield will also fall. A decline in tax yield will automatically lead to a reduction in budget surplus or an increase in budget deficits. Such an automatic decline in tax revenues acts to curb deflationary pressures. Similarly, we can apply the same reasoning if we assume the value for tax-income elasticity to be less than unity.

Thus variations in tax yields with a given tax system will tend to act as a cushion to variations in disposable income after taxes, and thereby lessen fluctuations in demand and income. This, in brief, is the mechanism of built-in flexibility as it operates in the tax side of the budget. The existence of the mechanism of built-in flexibility is particularly valuable where policy initiation is rigid or where frequent changes in tax structures are held undesirable for other reasons, which have come into limelight since World War II.

The mechanism of built-in flexibility was expounded by R. A. Musgrave and M. H. Miller in 1948,[1] and many fiscal theorists since then have been interested in this concept. Later research mainly centered on the quantative analysis of built-in flexibility in the case of various

* Lecturer (*Kōshi*) of Economics.

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[1] R. A. Musgrave and M. H. Miller, "Built-in Flexibility," *American Economic Review*, March 1948, reprinted in *Readings in Fiscal Policy*, American Economic Association, 1955.

countries. The most fundamental contribution of such quantative analyses was the calculation of the actual values of tax-income elasticity in the case of many countries. The aim of this paper is to devise a proper method of measurement and with this help try to measure the actual tax-income elasticity in the case of Pre and Postwar Japan.

II. *A Theoretical Framework*

To measure the magnitude of tax-income elasticity, it is useful to start with a definite formula. Tax-income elasticity E_T may be denoted as

$$E_T=\frac{dT}{T}\Big/\frac{dY}{Y} \tag{1}$$

$$=\frac{dT}{dY}\Big/\frac{T}{Y}=\frac{M_t}{A_t} \tag{2}$$

where

Y is the national income

T is the tax yield

A_t is the average tax rate

M_t is the marginal tax rate

First, it may be pointed from the elasticity formula (1) that E_T measures the percentage change in T that results from a given percentage change in Y. The denominator shows the rate of increase in the national income, or the rate of economic growth. Therefore if it is possible to forecast the growth rate in the following year, E_T could be made use of so as to estimate roughly the percentage change in the tax yield and to make up the next budget. Second, E_T can be rewritten as the ratio of marginal tax rate M_t to average tax rate A_t as is seen in the formula (2). The different type of tax structures, progressive, proportional and regressive, may be easily defined depending on whether $M_t \gtreqless A_t$.

The responses of taxes to a change in the national income logically divides itself into two stages; in the first place, the response of the particular component of national income—taxable income—on which the tax is based to changes in the national income, and in the second place, the response of tax yield to a change in tax base. In order to inquire into these factors more closely, let us divide (2) into two stages[2] as follows:

Thus we obtain

$$E_T=\frac{dT}{T}\Big/\frac{dY}{Y}=\frac{dT}{T}\Big/\frac{dB}{B}\times\frac{dB}{B}\Big/\frac{dY}{Y}=E_t\cdot E_b \tag{3}$$

as the new expression for E_T, if B stands for the tax base, $E_t=\frac{dT}{T}\Big/\frac{dB}{B}$ and $E_b=\frac{dB}{B}\Big/\frac{dY}{Y}$.

The elasticity of the tax yield E_T can be represented as the product of the elasticities of (1) the tax yield with regard to changes in the tax base E_t and (2) the tax base with respect to changes in total income E_b. E_T varies directly with the elasticities of E_t and E_b. The first "tax-rate elasticity" relies greatly on the statutory-rate formula such as a progressive schedule of income tax rates. While the second "tax-base elasticity" is primarily determined

[2] Cf. R. A. Musgrave, *The Theory of Public Finance*, New York, 1959, pp. 506-7, but my formulation is more simple than his. For another formulation, see W. Lewis, *Federal Fiscal Policy in the Postwar Recession*, Washington, 1962, p. 28.

by the way in which the private sector works during boom and slump periods. These elasticities will be considered separately in detail in the discussion later.

The value of E_T will vary considerately from one tax to another. In the case of income and corporate taxes, it may be generally considered to be high, depending on the rates and bases of the taxes.[3] The terms for E_t and E_b given in expression (3) could be the major reason for high values of E_T in the direct taxes. It may be noted that the progressive income tax should produce proportionately greater swings in tax yields than income. This is a typical characteristic of the progressive rates, and consequently $E_t>1$. On the other hand, the high E_T of the corporate tax seems to be in $E_b>1$ since it shows the volatile changes in the level of corporate profits over the cycle.

As regards indirect taxes, it appears that the values of E_T are lower barring a few exceptions.[4] Both E_t and E_b in the case of the indirect taxes cannot rise higher because of their proportional or regressive rates and stable tax bases.

The above-mentioned E_T would apply to a tax system as a whole, or a group of taxes. Its value can be no greater than that of its most elastic component. E_T in the total tax should be interpreted as a weighted average of elasticities of the component taxes and may be shown by W. Vickrey's formulation[5] as follows;

$$T=T_1+T_2 \tag{4}$$

where T is the aggregate yield, T_1 and T_2 are the yield of the two components.

Transposing (4) into (1), we get

$$\begin{aligned} E_T&=\frac{Y}{T}\frac{dT}{dY}=\frac{Y}{T_1+T_2}\frac{d}{dY}(T_1+T_2)\\ &=\frac{1}{T_1+T_2}\left(Y\frac{dT_1}{dY}+Y\frac{dT_2}{dY}\right)=\frac{T_1E_1+T_2E_2}{T_1+T_2}\\ &=\frac{T_1}{T}E_1+\frac{T_2}{T}E_2 \end{aligned} \tag{5}$$

E_1, E_2 are the elasticities of the components respectively, and the elasticity of the total tax is thus shown to be equal to the weighted average of the elasticities of the components, the "weights" being the respective yields. Therefore in the case of actual measurement, we should deal with several elasticities by type of the component taxes.

Since the concept of elasticity given above is concerned with the automatic aspects of tax response, the measurement of values for E_T requires estimates of that part of the change in actual recorded data which results from automatic rather than discretionary actions. So measuring E_T practically raises some serious difficulties. The most serious difficulty is, for example, that the data on tax collections during the postwar Japan reflect not only automatic response to changing income, but tax reductions enacted in tax code almost every year. They do not allow for a separation of the effects due to changes in tax code.

In general, the tax yield T may be assumed to depend on income Y, minimum standard of exemptions and deductions e, and statutory tax rates t. In other words, T is shown in the function of these factors,

$$T=T(Y, e, t) \tag{6}$$

[3] J. A. Maxwell, *Fiscal Policy*, New York, 1955, chaps. 12-13.

[4] J. A. Maxwell, *op.cit.*, chap. 14.

[5] See, W. Vickrey, "Some Limits to the Income Elasticity of Income Tax Yields," *Review of Economics and Statistics*, May 1949, p. 140.

T for measuring E_T should be collected on the assumption that e and t are fixed by the institutional setting. This means using the tax yield as reflected in income changes due to the "stable tax system." The assumption of "stable tax system" will be introduced in the argument to be developed here.

However, it is very hard to assume the tenability of the assumption of a stable tax system in the long run. As mentioned earlier, many tax reforms have been enacted in the postwar Japan, which make such an assumption unreasonable. Under such circumstances, it should be pointed out that we cannot hope to measure any elasticity in its strict sense of the term.

Actual tax yields must be adjusted for any changes in tax law by a meaningful method.[6] A tentative attempt has been made by Tax Bureau in the Ministry of Finance. It is a bold and crude attempt, but it is the only one which was made, and details of which is available at present in Japan.

The results of the tentative attempt in 1959-60 is summarized in Table 1. It is shown that the tax-income elasticity was 1.33 in 1959 and 1.70 in 1960. Adjustments are made for statutory changes that were made in the tax code during this period. The Tax Bureau converted actual taxes to assumed tax accruals, and the results are shown in column (5). This conversion was made on the basis of the assumption of the absence of tax code changes, that is, unchanged rates, exemptions and deductions. Assumed tax accruals in the current year are then compared with actual tax in the preceding year.

TABLE 1. THE *GNP* ELASTICITY OF THE TAX YIELD
(a tentative calculation)

		1959	1960
(1)	*GNP*	13,377	16,047
(2)	percentage of change from preceding year in (1)	116.1	120.0
(3)	actual tax revenue in general account	1,213	1,618
(4)	percentage of change from preceding year in (3)	117.6	133.4
(5)	an assumed tax in the absence of tax code changes	1,253	1,626
(6)	$\frac{\text{current year (5)}}{\text{preceding year (3)}}$	121.4	134.0
(7)	tax-income elasticity $\frac{(6)-100}{(2)-100}$	1.33	1.70

Source: *Reference Materials for the Tax System* (*Zeisei Shuyō Sankō Shiryōshū*), 1967, Tax Bureau in the Ministry of Finance.
Note: (1) (3) (5) billion yen
(2) (4) (6) %

It should be noted that there is a great deal of doubt as to the tenability of the results of the Tax Bureau series. Many criticisms have been voiced regarding the accuracy of the

[6] Lewis made the adjustments by simply multiplying actual recorded tax accruals by the ratio of pre-change to actual tax rates, see, *op. cit.*, pp. 29-31. Pechman also made the adjustment for tax revenues in terms of "Index of tax rates," based on estimates prepared by the Department of the Treasury, see J. A. Pechman, "Yield of the Individual Income Tax," *Policies to Combat Depression*, National Bureau of Economic Research, 1956, p. 144.

methods used and the conclusion, generally, is that the results are inaccurate.[7] First, it can be pointed out that assumed tax accruals should never be derived under the assumption of a "stable tax system" when there are no changes in tax law. Almost every year many changes are enacted and this justifies the assumption of "unstable tax system."

Second, this procedure does not take into account the complications which arise from the fact that changes in tax law are reflected in the tax bases. It can be argued that, in the absence of a change in tax rates or exemptions, the whole time-shape of recession and recovery will differ with the result that tax base gets changed. Suppose, a reduction of corporate tax occurs in the current year. This tax reduction would have a beneficial influence on business activity and will tend to alter the quantum of corporate profits. Nevertheless, according to the Tax Bureau method the current changed tax base will be compared to the preceding unchanged tax rates or deductions. Hence, a large inconsistent "gap" is necessarily found between the changed tax base and the unchanged tax rates or deductions.

Third, such an inconsistent gap may appear between national income and tax revenues, too. Even if tax revenues can be adjusted by the Tax Bureau method, the adjusted tax yields would be related to the national income that was a product of the influence of tax reforms and the like. Such an attempt is theoretically untenable and hence the correlation could be misleading.

As a consequence, such an attempt as test of the Tax Bureau would do away with the essential aspects of tax-income elasticity which are essential to show the cyclical pattern of changes in tax yields if there is no change in the tax system. Because of these reasons the usual Tax Bureau method might no longer be a useful tool of analysis. An affirmative is to give up the attempt of measuring E_T on account of the above mentioned difficulties, in particular, since the validity of the analysis depends significantly on the assumption of a "stable tax system." We will attempt to show in this paper that E_T can be measured by another workable approximation, using what may be called a "stable" setting for the tax system.

III. *Measurement Using Quarterly Data*

We have already discussed the extent of changes in tax laws and its influences on the measurement of the elasticity. In the first place, we shall examine the above influence with reference to postwar Japan. Table 2 summarizes the quantative aspects of tax reductions since 1950.

Tax reforms have been enacted more often in the field of direct taxes—columns (1) and (2), than in the field of indirect taxes—columns (3)-(7). Since direct taxes form the more significant element of tax-income elasticity, an analysis of these taxes would help in the estimation of the elasticity. On a closer examination of Table 2, we find that the year 1960 alone was the only year which was not subject to any statutory changes among the entire postwar period.

Let us now begin with the discussion from this interesting result. The fact that no tax reform was put into effect in 1960 implies that the maintenance of a "stable tax system" was a possibility at least for the two years 1959-60 and that taxes were collected with the help of the tax system which was in vogue in 1959. By using the quarterly data on tax yields,

[7] Y. Hayashi, *Built-in Stabilizers* (in Japanese), 1960, pp. 274 f.

TABLE 2. TAX REDUCTIONS BY THE TAX REFORMS
(full accrual basis in the tax year)

(billion yen)

	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965
Income tax	135.8	60.5	112.7	77.3	31.4	53.3	22.6	110.2	6.3	23.1	—	56.3	50.3	66.8	74.5	65.4
Corporate tax	24.4	4.5	+19.1	15.5	2.6	12.0	+14.4	+21.9	21.5	3.8	—	39.9	1.3	+12.8	58.6	56.6
Liquor tax	—	44.0	—	38.4	+3.4	—	—	—	6.3	—	—	—	37.2	—	—	—
Sugar excise	—	+5.8	+5.7	+6.0	+6.2	—	—	—	—	—	—	—	—	—	—	—
Gasoline tax	—	2.5	—	—	+3.8	—	—	+22.8	—	+23.3	—	+21.8	—	—	+25.4	—
Commodity tax	—	10.2	2.1	3.0	+1.1	0.6	0.3	—	—	3.1	—	0.4	20.2	—	—	+3.4
Stamp revenues	2.0	0.1	—	—	+5.5	—	—	+3.0	—	0.5	—	—	1.8	—	—	0.2

Source: *Primary Reference Materials of Taxation* (Zeisei Shuyō Sankō Shiryōshū), Tax Bureau, Ministry of Finance, 1964 and 1967.

Note: The figures with + show the tax increases. Gasoline tax includes local road tax. "Full accrual basis" means the second year after the tax law is changed, and the initial year may be called "part-yearly basis in the tax year."

we can measure the elasticity based on eight observations in the sample. In order to measure the elasticity we shall try to construct a simple regression equation of logarithmic type by using the least squares method in order to measure it as follows:

$$\log T=\alpha \log Y+k \tag{7}$$

where α represents tax-income elasticity.

The necessary data to be used are shown in Table 3 and 4. Perhaps two points deserve mention in these tables. First, Y is defined as the net national product *NNP* at market price, in which indirect taxes are usually included and subsidies excluded. National income, which generally means the net national product at factor cost, may not be useful for our measurement because indirect taxes are excluded.[8]

TABLE 3. *NNP* AND INCOME TAX REVENUES
(in billion of current yen)

Calendar Year Quarters		*NNP*	Withheld Tax		Declarations Estimated Tax	
			no-lag	1-month lag	no-lag	3-month lag
1959	I	2,391.4	52.3	35.4	23.9	6.3
	II	2,531.1	40.0	54.7	6.3	14.1
	III	2,802.3	65.0	51.7	14.1	14.1
	IV	3,750.9	45.0	66.5	14.1	30.8
1960	I	2,818.6	59.4	38.4	30.8	9.2
	II	3,151.7	51.4	74.3	9.2	17.9
	III	3,385.1	90.8	73.5	17.9	18.8
	IV	4,489.1	64.5	97.8	18.8	48.3
		As percentage of preceding year (%)				
1959	I	71.5	121.9	59.8	152.3	26.2
	II	105.8	76.6	154.6	26.2	225.2
	III	110.7	172.2	94.4	225.2	100.0
	IV	133.9	69.3	128.6	100.0	219.2
1960	I	75.1	132.1	57.7	219.2	29.8
	II	111.8	86.5	193.7	29.8	194.2
	III	107.4	176.6	98.9	194.2	105.1
	IV	132.6	71.0	133.1	105.1	257.3

Source: *NNP* figures are from *Annual Report on National Income Statistics*, 1967, Economic Planning Agency. Tax figures are from *Monthly Report on Fiscal-Monetary Statistics* (Zaisei Kinyū Tōkei Geppō), 1959-1960, The Ministry of Finance.

Second, the question of time lags is pertinent in tax collections. Because of the collection lags, the tax yield shows a distinctly slower response to income accruals and lags a few months behind the change in income. Thus institutional factors should be taken into account in our discussion. The time lag between income accrued and tax collected differs for each of these components of the taxes, and the response of each to income changes varies accordingly. The lag is important in the case of direct taxes and can be clearly seen in the case the personal income tax which is collected by employers through the withholding of a percentage of current wages and salaries. As provided for in tax law, the withheld income tax must be paid the next month after taxable income accrues, and so it is sometimes assumed

[8] For similar discussion, see G. A. Bishop, "The Tax Burden by Income Class, 1958," *National Tax Journal*, March 1961, pp. 44-6.

TABLE 4. *NNP* AND CORPORATE TAX REVENUES
(in billion of current yen)

Calendar Year	Quarters	*NNP*	Tax Revenues					
			no-lag	1-month lag	2-month lag	3-month lag	4-month lag	5-month lag
1958	I	2,267.2	78.9	82.2	95.4	87.8	95.8	62.2
	II	2,266.8	87.8	95.8	62.2	66.2	58.7	60.1
	III	2,448.0	66.2	58.7	60.1	81.3	89.7	94.6
	IV	3,342.5	81.3	89.5	94.6	66.6	56.6	46.8
1959	I	2,391.4	66.6	56.6	46.8	101.5	114.1	83.1
	II	2,531.1	101.5	114.1	83.1	73.4	66.1	105.9
	III	2,802.3	73.4	66.1	105.9	112.4	114.4	96.8
	IV	3,750.9	112.4	114.4	96.8	95.3	94.2	138.4
1960	I	2,818.6	95.3	94.2	138.5	147.5	162.2	124.1
	II	3,151.7	147.5	162.2	124.1	116.6	109.2	147.4
	III	3,385.1	116.6	109.2	147.4	158.0	171.6	143.4
	IV	4,489.1	158.0	171.6	143.4	142.3	127.2	185.6
1961	I	3,357.7	142.2	127.2	185.6			
		As percentage of preceding year (%)						
1958	II	99.9	111.2	116.5	65.1	75.3	61.2	96.6
	III	107.9	75.3	61.2	96.6	122.8	152.4	202.1
	IV	136.5	122.8	152.4	202.1	81.9	63.2	49.4
1959	I	71.5	81.9	63.2	49.4	152.3	201.5	177.5
	II	105.8	152.3	201.5	177.5	72.3	57.9	127.5
	III	110.7	72.3	57.9	127.5	153.3	173.0	91.4
	IV	133.9	153.3	173.0	91.4	84.8	82.4	143.1
1960	I	75.1	84.8	82.4	143.1	154.7	172.1	89.6
	II	111.8	154.7	172.1	89.6	79.0	67.4	118.8
	III	107.4	79.0	67.4	118.8	135.6	157.1	97.3
	IV	132.6	135.6	157.1	97.3	89.9	74.1	129.4
1961	I	74.8	89.9	74.1	129.4	137.4	169.3	88.1

Source: *ibid.*

that there is a 1-month lag between tax collection and income accruals.[9] A question arises, namely, in case of actual measurement of tax lags which should be adjusted—income accruals or tax collections? Theoretically speaking, income accruals ought to be adjusted rather than tax collections, but any monthly data regarding national income is not available because most of the data required for examining time lags in the national income is annual or quarterly in nature. Hence empirically, we are forced to set some lags on the tax side as monthly data is available without any difficulty. However, when we compare Y and T in the withheld income tax with allowing no lag on the one hand and allowing one month lag on the other, we find a better fit for the latter case as shown in Table 5.

The problem of time lag in tax collections may be more difficult in the case of other types of income tax. Individuals whose income can't be withheld or the extent of whose withholdings of income is insufficient, file and pay a declaration of self-assessed tax several times per year. Final payment is made by March 15 of the year after the tax year in Japan or alternatively a refund is claimed for any overpayment or underpayment of withheld or self-assessed taxes. Thus the self-assessed portion of the tax declaration seems to be based

[9] *The Laws and Regulations Related to the Income Tax* (Shotokuzei Kankei Hōkishū), Tax Administration Agency.

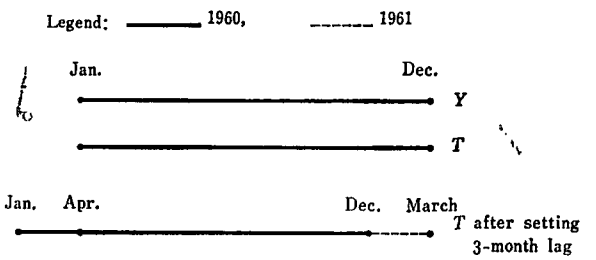
on no simple lag like the type where income is withheld, because most of taxable income on the basis of self-assessment has usually been accrued about a year earlier. Therefore it is not easy to set any definite monthly lags. One possible method is to measure the elasticity as in formula (1), by making use of the annual data for two years.

The other method is to assume roughly a 3-month lag, according to the provision of tax laws, in which we find the receipt of taxable income from January to December must be reported finally by March 15. Furthermore there is a provisional return system, and tax payment in some installments during the year. Thus it is probably plausible to assume a 3-month lag, although it might not seem so good at first. The coefficient of determination made such an assumption shows the highest value as seen in Table 5.

The collection lag in the case of corporate tax poses a special problem, namely it is impossible to assume a single lag, judging from the very method of tax collection.[10] The provision of corporate tax laws point out clearly that taxed corporations should declare in less than two months after the settlement of its accounts and that at the same time it should pay half of tax bills, the rest of which is permitted to be paid separately in three months later. Actually, there is no basis for judging how the corporate tax will lag behind income. Therefore it may be assumed that there are several lags ranging from the no-lag to the 5-month lag in the case of short run,[11] rather than a simple lag like that in the case withheld income tax. After constructing a regression in (7), the case with the highest coefficient of determination will be determined and regarded as an approximate result.

Another problem will appear in setting lags. In reality no lag should be set on the tax side. In our method which makes adjustment regarding the tax revenues, the longer is the monthly lags like in case of the corporate tax, the shorter will be the significant part of the tax year which remains uninfluenced by tax reforms. This may be clearly seen in Chart 1, and is illustrated with the help of T and Y as in 1960. Initially T and Y correspond to a case before the introduction of monthly lags. Once, for example, 3-month lag is

CHART 1



introduced in the picture, T scale will shift towards the left and shorten the portion of the 1960 tax year relevant for correlating with Y in 1960. Consequently, the number of observations in each case will decrease when we make a regression as shown in Table 5.

[10] *The Laws and Regulations Related to the Corporate Tax* (Hōjinzei Kankei Hōkishū), Tax Administration Agency.

[11] But the lag problem in the corporate tax will be not so easy as under this discussion. It is suggested that there are more than 2 years lags between income and tax. For a fuller discussion, see K. Ohhara, "Fluctuations in the National Income and Tax Revenues" (in Japanese), *Monthly Report of Fiscal-monetary Statistics*, vol. 110.

However, because of the long period of monthly lags, the number of observations tends to become too shortened to measure E_T in some cases of corporate tax. Turning to Table 2, the amount of tax reduction was very small in 1959 compared with the other years, and was almost negligible. It might be assumed that the tax system for 1958–60 was comparatively "stable" in the sense of small tax change. Thus we can extend the period of measurement to the three-year stretches covered by the 12 quarterly data in the case of corporate tax. This procedure is also applied to the case of the 3-month lag in the self-assessed tax because of the above reasoning.

Table 5 summarizes the results of tax-income elasticity in postwar direct taxes on a quarterly basis. Each case is compared with the cases which lags are introduced. An important difference between income tax and corporate tax in the measurement of E_T should be noted (see column (2)). Apart from the above mentioned reasons, the very basis of tax collection in the case of income and corporate taxes is different, for, while in the former the tax collection is based on the calendar year, in the latter it is the fiscal year which is important.

TABLE 5. POSTWAR TAX-INCOME ELASTICITY E_T OF DIRECT TAXES

Tax	Monthly lags	Period of measurement	The number of observations	E_T	$\bar{R}^2$	Weights (%)
Withheld income tax	no	1959. I–1960. IV	8	0.3793	0.0510	
	1	do.	8	1.4054	0.6841*	30.82
Self-assessed income tax	no	do.	8	0.2396	0.0097	
	3	1959. I–1960. III	7	2.8232	0.7227*	10.14
Corporate tax	no	1958. II–1961. I	12	1.0820	0.4563*	
	1	do.	12	1.2043	0.4184*	
	2	do.	12	1.4619	0.4667*	59.04
	3	1958. II–1960. IV	11	0.7284	0.1538	
	4	do.	11	0.5905	0.0111	
	5	do.	11	1.0745	0.2322	

Note: $\bar{R}^2$ is the coefficient of determination "adjusted" for the number of observations in the sample and for the number of constants in the equation. The values for $\bar{R}^2$ with * are in the 5 per cent level of significance. This is to be repeated in the following Tables. Weights are computed by the total tax revenues for 1959–60 which are to be used in the weighted-average of E_T.

According to the principle as indicated earlier for the selection of cases, the one with a higher degree of $\bar{R}^2$ will be preferred as regards taxes. E_T is 1.4054 in the case of 1-month lagged withheld income tax, 2.8232 in the case of self-assessed income tax with a 3-month lag, and 1.4619 for corporate tax with the 2-month lag. It may be argued from such a rough estimate that the direct taxes would have a fairly cyclical sensitivity as one should expect. In particular, the value of E_T in the case of the self-assessed tax is the highest. Furthermore, it should be noted that this result is accidentally almost equal to that arrived at by use of the elasticity formula (1), that is $E_T=2.8385$. This result may be surprising. While the result of withheld tax is reasonable, the value of E_T in the corporate tax seems to be lower than we expected and will be explained by the value for E_b later.

In order to estimate the value of E_T for the direct tax structure as a whole, E_T must be

computed as the weighted average of the elasticities of the three taxes that compose it. E_T in this case is 1.5825 which seems to conform to our expectations.

Next, let us turn to the values for tax-base elasticity E_b. The data needed for the measurement are shown in Table 6. It may be pointed out that there are some differences between personal or corporate income for tax purposes and the corresponding incomes as estimated by the Economic Planning Agency (EPA). Though total reported income for tax evaluation purposes should be normally selected as tax bases, the relevant data cannot be found on a quarterly basis. Therefore calculation of taxable income in Table 6 has to be based on the national income statistics in spite of the conceptual differences.

TABLE 6. TAX BASES IN DIRECT TAXES

(billion yen, %)

Calendar Year	Quarters	Withheld Income Tax: Compensation of employees (1)	(2)	Self-assessed Income Tax: Income from unincorporated enterprises and from property (1)	(2)	Corporate Tax: Corporate income before tax (1)	(2)
1958	II					254.5	84.1
	III					239.3	94.0
	IV					218.4	91.2
1959	I	1,155.2	79.4	712.0	49.5	207.2	94.8
	II	1,273.3	110.2	776.4	109.0	290.4	140.2
	III	1,337.5	105.0	892.4	114.9	284.2	97.9
	IV	1,626.0	121.6	1,531.9	171.7	336.6	118.4
1960	I	1,287.0	79.2	811.8	53.0	385.7	114.6
	II	1,485.7	115.4	931.5	114.7	485.7	125.9
	III	1,539.8	103.6	1,027.5	110.3	467.3	96.2
	IV	1,945.4	126.3	1,763.8	171.7	495.4	106.0
1961	I					486.2	98.2

Source: *Annual Report on National Income Statistics*, 1967.
Note: (1)—amount, (2)—per cent of preceding year.

E_T is to a certain extent affected by E_b as estimated in Table 7. For instance, it can be argued that the high value for E_T in the corporate tax is primarily caused by volatility in the level of corporate income over the cycle, that is, the high value of E_b although the rate and structure adds little additional sensitivity to the corporate tax. But it is much lower than was expected. This seems to be, in turn, the prime reason for the low value of E_T in the corporate tax as we mentioned earlier. In addition, the goodness of fit is not very satisfactory, though it is not rejected at the 5 per cent level of significance. A basic reason for this low value may be that the quarterly estimate of corporate income in the national income statistics is incorrect and incomplete.[12]

On the contrary, the value of E_b for income taxes serves to point out the reason for the high tax-income elasticity. The value of the self-assessed tax is, of cource, higher than that of the withheld tax because its tax base is considered to be more volatile. Tax-rate elasticity E_t must also be high because of the progressiveness of the tax rate. Thus the great magnitude of E_T in the self-assessed tax can be explained by the high E_b associated with the high E_t. The value of E_t in the withheld tax will exceed unity to a large extent since $E_b<1$ as shown in

[12] See, K. Ohkawa ed., *National Income* (Kokumin Shotoku), 1960, p. 183.

TABLE 7. POSTWAR TAX-BASE ELASTICITY E_b OF DIRECT TAXES

	E_b	$\bar{R}^2$
Withheld Income Tax	0.7803	0.9745*
Self-assessed Income Tax	1.4990	0.9205*
Corporate Tax	1.0711	0.3833*

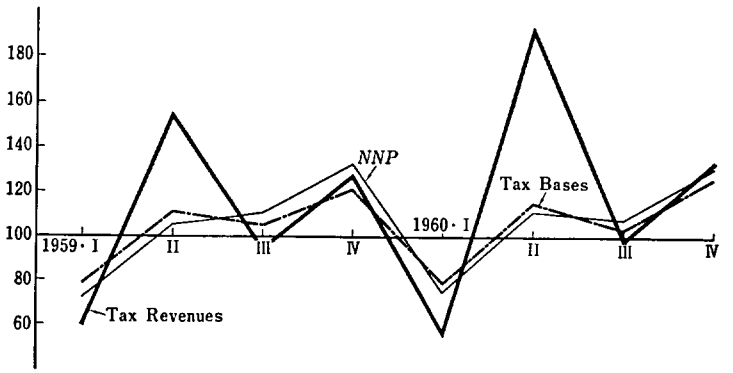
Note: See Table 6 for tax bases and Table 5 for the period of measurement.

Table 7.

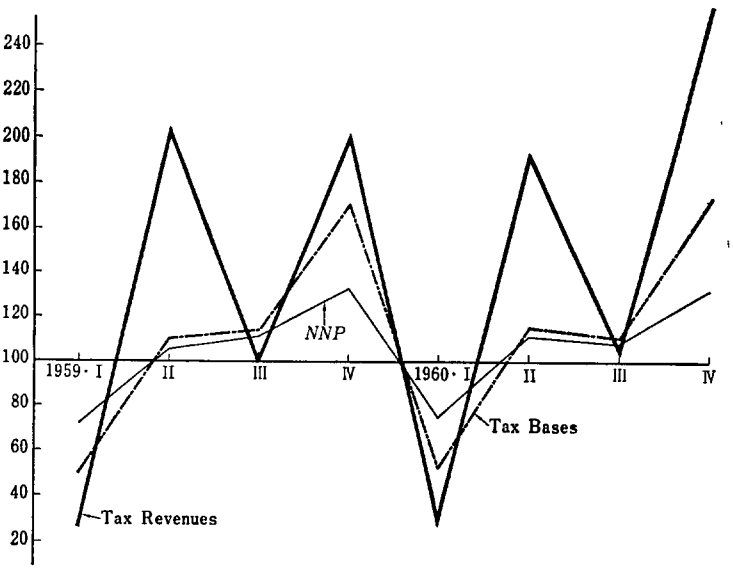
Chart 2 shows these relations graphically. The cyclical patterns of changes in *NNP*, tax revenues and tax bases of various types are shown by the three lines, each representing

CHART 2. POSTWAR *NNP*, TAX REVENUES AND TAX BASES AS A PERCENTAGE OF THE PRECEDING YEAR

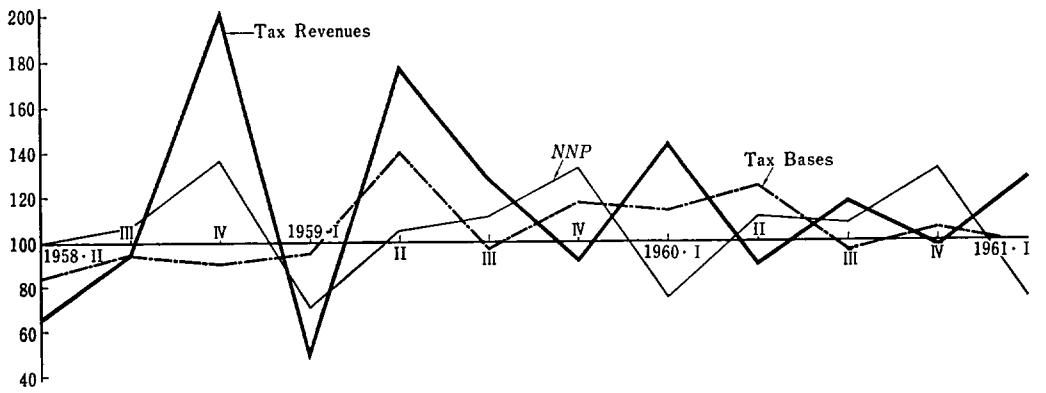
(a) Withheld Income Tax, 1-month Lag



(b) Self-assessed Income Tax, 3-month Lag



(c) Corporate Tax, 2-month Lag



percentages of the preceding year. In the first place, the explicit cyclical phenomenon that stands out in Chart 2-(a) and (b) is the correspondence of the three lines from peak to trough, while in Chart 2-(c) the correspondence becomes vague. It can be seen from the Chart that the income tax changes more sharply than *NNP*, and that the tax base particularly in the self-assessed tax tends to follow the same patterns. On the other hand, this tendency cannot be found explicitly in the corporate tax case. These features serve to support the results of the elasticities computed earlier and especially in the corporate tax they are perhaps the major reason why the goodness of fit in making a regression is not very satisfactory.

IV. *Measurement Using Annual Data*

It is difficult to apply the measurement based on quarterly data to the indirect tax system in the postwar period. The major reason is that the results of E_T measured on the basis of quarterly data for the period 1959–60 are unsatisfactory and questionable in all cases. For example, the value of E_T in the commodity tax, which can be expected to be the most elastic among the indirect taxes, is only 0.2695 in fact, and what is worse, $\bar{R}^2$ is rejected at the 5 per cent level of significance. The same phenomenon tends to repeat itself in the other type of indirect taxes.[18] Consequently one should conclude that computation on a quarterly basis is unsound in the case of indirect taxes. An alternative method of measurement must be resorted to.

Let us turn back to Table 2 again. It may be pointed that there were very small and negligible changes in the tax law for the period 1955–61, except in the case of gasoline excise. Since seven observations in the sample can be obtained from seven tax years, it is enough to make a regression in (7). Instead of working with quarterly data, a measurement in terms of the annual data could be made for the postwar period about the elasticity of the indirect taxes.

To a lesser extent, the same problem arises with respect to lags in tax collection. Most of the indirect taxes must be paid in principle the next month after accrual of taxable items,

[18] The other results are as follows; liquor tax, $E_T=0.3189$, $\bar{R}^2=0.2522$, sugar excise, $E_T=0.5597$, $\bar{R}^2=0.3642$, gasoline excise, $E_T=0.5374$, $\bar{R}^2=0.3040$, and so forth.

but payment of certain taxes (such as the liquor and commodity taxes) are permitted to be postponed another month. In the case of other types of taxes (such as customs and stamp revenues), the problems for collection lags may not appear for the payment is made immediately after accrual of taxable items.[14] But such lags do not seem to have a great influence on the final result of E_T which should be computed from the annual data, and it was obtained by correlating *NNP* with the tax yield as it stands for the period 1955–61.

For measuring E_T in indirect taxes, seven types of taxes were selected in this paper; liquor tax, sugar excise, gasoline excise (including local road tax), commodity tax, customs, government monopoly profits (the most of which are covered by tobacco excise) and stamp revenues. The total of these taxes accounts for over 96 per cent of the indirect taxes as a whole in 1960. For the rest, the exchange tax and the securities exchange tax, which are expected to be elastic, may be resorted to, but they are negligible in amount.

TABLE 8. *NNP* AND INDIRECT TAX REVENUES

(in billions of current yen)

Fiscal Year	*NNP*	Liquor Tax	Sugar Excise	Commodity Tax	Gasoline Excise	Customs	Stamp Revenues	Government Monopoly Profits
1955	7,919	160.5	56.7	26.9	33.2	17.9	23.3	114.3
1956	8,835	172.8	68.2	32.9	38.5	32.1	28.5	114.8
1957	10,097	190.4	65.5	38.8	61.1	36.4	33.7	122.4
1958	10,449	195.6	74.3	47.5	70.1	33.2	36.3	126.4
1959	11,903	217.8	73.5	62.4	97.9	41.0	42.5	126.1
1960	14,384	248.5	78.3	82.2	121.8	59.6	50.6	147.0
1961	17,050	296.9	83.6	106.3	163.2	85.8	59.6	164.8

Source: *NNP* figures are from *Annual Report on National Income Statistics*, 1967. Tax figures are from *Primary Reference of Taxation* (Zeisei Shuyō Sankō Shiryōshū), Tax Bureau, Ministry of Finance, March 1967.

Note: Sugar excise includes the portion of customs for sugar consumption, and customs are adjusted by excluding that portion. Gasoline excise includes local road tax.

TABLE 9. POSTWAR TAX-INCOME ELASTICITY E_T AND TAX-BASE ELASTICITY E_b OF INDIRECT TAXES

	E_T	$\bar{R}^2$	Weights (%)	E_b	$\bar{R}^2$
Liquor tax	0.7913	0.9945*	33.22	0.8333	0.9749*
Sugar excise	0.4322	0.7924*	11.21	0.6029	0.9754*
Commodity tax	1.8284	0.9841*	8.90	1.5574	0.9824*
Gasoline excise	2.1390	0.9596*	13.13	2.1770	0.8557*
Customs	1.7828	0.9216*	6.86	—	—
Stamp revenues	1.1975	0.9795*	6.15	1.3242	0.8425*
Gov't monopoly profits	0.4951	0.9631*	20.52	0.5435	0.9829*

Note: Weights are computed by the total revenues for the period 1955–61.

[14] *The Laws and Regulations Related to the Liquor Tax* (Shuzei Kankei Hōkishū), *The Laws and Regulations Related to the Excise Taxes* (Shōhizei Kankei Hōkishū), Tax Administration Agency.

The data used for measuring E_T and E_b are shown in Table 8. Table 9 summarizes the final results of the elasticities in the postwar indirect taxes. The values of E_T for the liquor tax, sugar excise and government monopoly profits become less than unity and show little sensitivity as was expected. On the other hand, the commodity tax shows more cyclical patterns compared with these taxes. It appears that the sensitivity to cycles is attributable mainly to the fluctuations in demand and output of taxable commodities. The high value of E_T in the gasoline excise seems to have been caused by the rapid spread of automobiles which was a product of the high rate of economic growth in the thirties' of the Shōwa era (1955–65). The elastic nature of customs may be explained from the fact that they rely heavily on the cyclical patterns of imports.

However, we cannot but feel some hesitation in admitting that the values for E_T shown in Table 9 are equal to tax-income elasticity in the strict sense of the term. As was seen in Table 2, some taxes experienced to a certain extent the effect of changes in the tax code. Since tax reforms in the field of indirect taxes in general led changes in the tax rate, it should be admitted that the amount of tax bases itself changed almost exactly every year. As the taxes are flat-rate levies, this behavior must reflect tax-base elasticity rather than tax-rate elasticity; we obtain $E_T \fallingdotseq E_b$ from the expression (3) because $E_t=1$. Therefore E_b in the case of indirect taxes seems more useful since it permits us to explain the tax-income elasticity more directly.

The tax bases for indirect taxes are more specific, and much narrower, than those for income and corporate taxes. In addition, it is more difficult to put the data into order. The amounts and values of the taxable items should be treated as the tax bases as followed by a few of the statistical sources. The results are shown in Table 10. There are units of various types such as *tons*, *kl*, *kg*, *yen* and so on. The commodity tax alone is divided into three types and has relatively three bases for tax purposes; the first and second classes are collected on an ad valorem basis and the third on a specific basis. But the third type were neglected in connection with the weighted average for E_b of total commodity tax. This procedure will be permitted since the tax in question is only less than 3 per cent of the total commodity tax in 1960. Comparing E_T with E_b in Table 9, it might be pointed that both figures are approximately equal in all cases. Finally the tax base such as sales of gasoline and tobacco play an important role in the tax-income elasticity, rather than the tax yield itself.

The final computation of tax-income elasticity in the indirect taxes as a whole may be done on the basis of two methods. One is to make use of each value of E_T alone despite its statutory changes, and the weighted average in this case is 1.0533. The other is to substitute the part of E_T in which changes in tax laws were enacted for E_b, and the value obtained is 1.0845. A rough estimate would be that the tax-income elasticity in total indirect taxes accounts for about unity and is neutral to cyclical fluctuations.

The preceding analysis may be expanded to allow for the case in the prewar period. The two types of elasticities can be computed in a similar manner. First of all, the period for measurement when the tax system remained unchanged, or at least little changed must be found in the prewar period. Table 11 shows *NNP* and tax revenues for the period 1930–39. The years when tax reforms were enacted are given as the tax figures with *, and it should be noted that changes in tax code did not produce powerful effects on the tax system in the prewar period so much as in the postwar period, particularly in the case of income and corporate taxes. The period 1930–36 was selected due to the following two reasons. In the first

TABLE 10. POSTWAR TAX BASES OF INDIRECT TAXES

Tax	Liquor Tax	Sugar Excise	Commodity Tax		Gasoline Excise	Stamp Revenue	Gov't Monopoly Profits
			1st class	2nd class			
Tax Base	Taxable Volumes	Consumed Volumes	Taxable Volumes	Taxable Volumes	Taxable Volumes	Number of Deeds	Amount Sold on Tobacco
Unit	1000 kl	1000 ton	million yen	billion yen	1000 kl	1000	billion yen
Fiscal Year							
1955	1,392	1,518	2,297	219.3	952	47,510	223
1956	1,484	1,624	3,030	251.4	1,292	70,419	236
1957	1,619	1,649	3,795	296.2	1,949	58,097	250
1958	1,838	1,798	4,170	332.7	3,018	57,010	265
1959	1,965	1,933	7,662	437.2	3,578	81,287	282
1960	2,205	2,164	12,276	548.0	4,211	109,588	316
1961	2,642	2,386	18,381	679.1	4,993	138,307	332

Source: *Statistical Yearbook of the Tax Adiministration of Agency* (Kokuzeichō Tōkei Nenpōsho). *Monthly Report on Fiscal-Monetary Statistics.*

place, the official data of *NNP* as estimated by EPA are only available since 1930. In the second place, a large-scale change in tax law was enacted in 1937 to finance war expenditure. Hence there is a large gap in the tax system between pre- and post-1937. But it is assumed that the period 1930–36 can be considered to have maintained a comparatively stable tax system.

There are ten taxes for measurement of E_T and E_b in the postwar case as shown in Table 11. Tax bases of various types are recorded in Table 12. But we failed to pick up different kinds of tax bases on account of the limitation of sources. These values for E_T

TABLE 11. PREWAR *NNP* AND TAX REVENUES

(in billions of current yen)

	NNP	Income Tax	Business Profit Tax	Capital Interest Tax	Liquor Tax	Sugar Excise	Textile Excise	Exchange Tax	Customs	Stamp Revenue	Gov't Monopoly Profits
1930	12,973	200.6	54.4	15.7	218.9	77.9	33.9	9.1	105.4	69.7	198.3
1931	11,745	144.5	37.9*	14.8	188.8	77.4*	33.7*	11.8	114.3	65.5	190.5
1932	12,475	136.1	35.3*	14.3	177.4	72.7	29.1	15.0	105.4	66.7	177.9
1933	13,625	159.7	40.4	14.6	208.9	72.5	29.4	16.2	114.0	73.8	179.3
1934	14,436	196.4	48.6	14.9	218.4	75.0	35.7	14.5	144.4	78.0	192.6
1935	15,802	227.3	57.1	15.0	209.3	84.8	42.9	14.7	151.3	78.6	197.6*
1936	17,035	276.6	73.2	15.0	220.1	86.8	42.6	15.8	174.1	93.8	215.2
1937	20,269	478.5	91.3*	27.3*	241.5*	95.2*	38.9	30.1*	185.0	93.3	257.6
1938	21,821	732.8	105.3	33.1	278.7	145.9	46.9	25.0	166.4	91.4	261.3
1939	27,362	888.8	126.3	40.3	266.7	136.0	58.1	27.9	147.7	112.5	320.2

Source: *The Receipts List Since the First Year of Meiji*, Tax Bureau, Ministry of Finance, 1948. *The History of Finance in Shōwa Era* (Shōwa Zaiseishi), vol. 5, Ministry of Finance, 1957. M. Katsu, *The History of Tax Reforms in Japan* (Nihon Zeisei Kaikakushi), 1937.

Note: The figures with * show the taxes collected under some changes in tax law.

TABLE 12. PREWAR TAX BASES

Tax	Income Tax	Business Profit Tax	Capital Interest Tax	Sugar Excise	Textile Excise	Liquor Tax	Exchange Tax
Tax Base	Taxable Income	Pure Profits	Taxable Amount	Taxable Volume	Taxable Value	The Volume on Delivery	Contract Value
Unit	(million yen)	(million yen)	(million yen)	(million kg)	(million yen)	(thousand kl)	(million yen)
Fiscal Year							
1929	3,944.2	1,886.0	825.5	819.0	359.7	928.4	35,879
1930	3,883.4	1,825.8	801.3	798.6	341.5	811.9	37,374
1931	3,022.1	1,354.0	756.6	817.8	342.6	792.1	53,383
1932	2,874.4	1,330.0	731.7	783.6	310.2	757.5	68,681
1933	3,147.9	1,503.3	751.5	822.0	336.5	790.3	77,508
1934	3,579.0	1,818.2	767.1	882.6	412.9	818.5	67,101
1935	4,021.5	2,148.6	781.3	952.2	452.5	811.0	69,614
1936	4,680.0	2,601.0	782.5	1,083.0	481.4	848.1	72,152

Source: *Statistical Yearbook of Tax Bureau*, 1929-36.

Note: In the case of liquor tax, the liquor year, Oct.-Sep., was adjusted into the fiscal year, April-March.

and E_b are estimated in Table 13. The noticeable point is that only a few cases are in the 5 per cent level of significance while most of them are rejected. It seems implausible to correlate *NNP* with tax revenues in the prewar period unlike in the postwar period. Income tax, customs and stamp revenues alone give the significant results statistically, and these values of E_T may be considered as satisfactorily as in the postwar cases. It is disappointing that we could not find a high degree of $\bar{R}^2$ for the liquor tax, sugar excise and government monopoly profits, which in the postwar period showed a good fit in the equation. If this turns out to be the case, these taxes might be viewed as having no relations with income change, and in a sense no cyclical sensitivity.

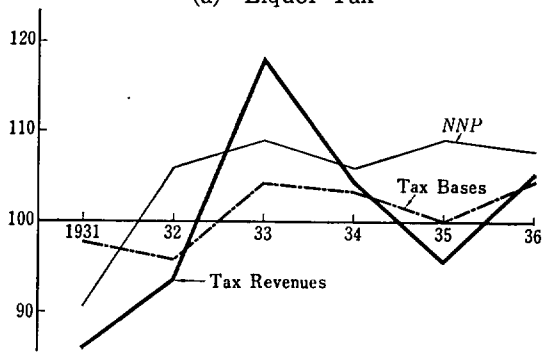
TABLE 13. PREWAR TAX-INCOME ELASTICITY E_T AND TAX-BASE ELASTICITY E_b

	E_T	R	Weights (%)	E_b	R
Income Tax	1.7480	0.7800*	19.40	1.1358	0.6743*
Business Profit Tax	1.6883	0.6847	5.01	1.7358	0.8306*
Capital Interest Tax	0.0440	0.0407	1.51	0.1074	0.0643
Liquor Tax	0.4222	0.3344	20.96	0.2050	0.5089
Sugar Excise	0.3966	0.4507	7.90	0.8177	0.8273*
Textile Excise	0.9462	0.5617	3.57	1.1760	0.8128*
Exchange Tax	0.7699	0.0921	1.40	0.8929	0.0620
Customs	1.3820	0.8029*	13.13	—	—
Stamp Revenue	0.8986	0.9083*	7.61	—	—
Gov't Monopoly Profits	0.3417	0.3773	19.51	—	—

Note: Weights are computed by the total tax revenues for the period 1930-36.

CHART 3. PREWAR *NNP*, TAX REVENUES AND TAX BASES OF LIQUOR TAX AND SUGAR EXCISE
(As a percentage of the preceding year)

(a) Liquor Tax



(b) Sugar Excise

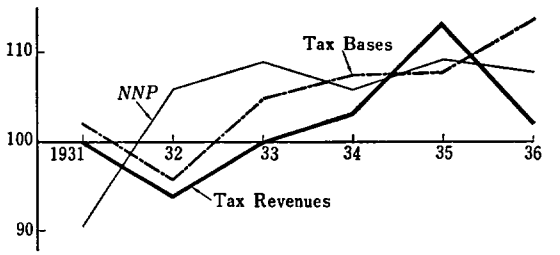


Chart 3 shows these relations graphically about the liquor tax and sugar excise. The same lines as noted earlier in Chart 2 cannot generally show coincident timing from peak to trough. This chart may be helpful to support the tenet of less significant correlation between income and certain kinds of taxes in the prewar period. Assuming that E_T without • is equal to zero, tax-income elasticity of the tax structure as a whole in the prewar era would be 0.6735 as the weighted average. Even if part of E_T is substituted for E_b, the value is still a low 0.7801. It implies that the tax structure in the prewar era was not built to a great extent on the sensitivity to cycles.

V. *Some Implications*

It should be recognized that we have been dealing with only one of a number of possible measures, and as a result our concluding remarks will be extremely limited and preliminary. These must, of course, be supplemented by other measurements. But as demonstrated in the preceding discussion, rough approximations were absolutely necessary at crucial points in the analysis. Our result indicates that a significant estimate can be made in the sphere of tax-income elasticity, though merely in a limited sense. Based on this optimistic estimate, we are left with the conclusion that the result may probably be accurate enough to support the usual inferences.

It is clear, however, that further research ought to be done, especially in the field of the treatment of data and analytical method. For instance, the tax-income elasticity of the tax structure as a whole in the postwar era cannot be computed because the two methods of measurement were separately applied for direct and indirect taxes on account of the absence of such data. Use of quarterly data can also be open to criticism with regard to statistical significance. Clearly a major proportion of this paper's deficiencies may well be due to that reason. Moreover the lag setting poses a difficult problem, and it may safely be said that the collection lags of the corporate tax will be incomprehensible in the short and long-run. In order to get estimates here, a more detailed analysis will be needed, but it is beyond the scope of this paper. Therefore some of inferences derived from our analysis are merely results based on the scanty data available at present in Japan.

However, the significant results of our analysis can be summarized briefly as follows:

1) The value of tax-income elasticity in the direct taxes is roughly 1.5. It is suggested that it will give a more elastic result than that in the indirect taxes, but to a lesser extent than might be expected. Although it was estimated over the extremely short period of the postwar years, it seems to provide some information supporting the viewpoint we expected at the outset.

2) As regards the indirect taxes, it seems that our result also conforms to expectations. Some specific components are more elastic and even more sensible to cycles than the income tax, but the others show a low value for elasticities. Consequently, the value of tax-income elasticity for the indirect tax structure as a whole is likely to be in the neighborhood of unity, but less than that of the direct taxes.

3) It appears that the tax revenues of the prewar years never fluctuated directly with changes in the national income, or at least not so consistently as in the postwar era. Also correlation between *NNP* and tax revenues of various types are not very clear. It may be pointed out that barring a few exceptions the tax system had not yet developed any so-called built-in flexibility.